In the claims

Cancel claims 1-12.

1.- 12. (Canceled)

13. (Original) A method of making a read head that has an air bearing surface (ABS) comprising the steps of:

forming a ferromagnetic first shield layer;

forming an antiferromagnetic pinning layer on the first shield layer;

forming a ferromagnetic pinned layer on and exchange coupled to the pinning layer so that the pinning layer pins a magnetic moment of the pinned layer;

forming a nonmagnetic spacer layer on the pinned layer;

forming a first portion of a free layer on the spacer layer;

forming a nonmagnetic cap layer on the first portion of the free layer;

forming a mask on the cap layer with a width that defines a track width of the read head;

milling away exposed portions of the cap layer, a portion of the free layer, spacer layer and pinned layer and backfilling with an electrically nonconductive antiferromagnetic material to form first and second antiferromagnetic (AFM) layers interfacing first and second side surfaces of remaining portions of the cap layer, a portion of the free layer, spacer layer and pinned layer;

removing the mask;

removing a remaining portion of the cap layer down to a remaining first portion of the free layer;

forming a second portion of a free layer on the remaining first portion of the free layer and on each of the first and second AFM layers; and

forming a ferromagnetic second shield layer on the second portion of the free layer.

14. (Original) A method of making a read head as claimed in claim 13 wherein the first and second AFM layers are formed of nickel oxide.

15. (Original) A method of making a read head that has an air bearing surface (ABS) comprising the steps of:

forming a ferromagnetic first shield layer;

forming a free layer on the first shield layer;

forming a nonmagnetic spacer layer on the free layer;

forming a ferromagnetic pinned layer on the spacer layer with a magnetic moment;

forming an antiferromagnetic pinning layer on the pinned layer for pinning the magnetic moment of the pinned layer;

forming a nonmagnetic cap layer on the pinning layer;

forming a mask on the cap layer with a width that defines a track width of the read head; milling away all exposed portions of the cap layer, pinning layer, pinned layer and spacer layer down to the free layer so that first and second side portions of the free layer are exposed beyond the track width and backfilling with an insulating antiferromagnetic material to form first and second insulative antiferromagnetic (AFM) layers which interface and are exchange coupled with said first and second side portions of the free layer respectively; and

forming a ferromagnetic second shield layer on the cap layer and the first and second AFM layers.

16. (Original) A method of making a read head as claimed in claim 15 wherein the first and second AFM layers are formed of nickel oxide.

17. (Original) A method of making a magnetic head assembly that has an air bearing surface (ABS) comprising the steps of:

making a read head including the steps of:

forming a current perpendicular to planes (CPP) sensor having a central portion which defines a track width of the read head and first and second side portions on each side of the central portion;

a making of said central portion of the sensor including the steps of:

forming a ferromagnetic pinned layer that has a magnetic moment;

forming an antiferromagnetic pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer;

forming a ferromagnetic free layer structure that has a magnetic moment; and

forming a nonmagnetic spacer layer between the free layer structure and the pinned layer;

a making of said first and second side portions of the sensor including the steps of:

forming first and second lateral extensions of the free layer structure in said first and second side portions respectively; and

forming first and second electrically nonconductive antiferromagnetic (AFM) layers exchange coupled to the first and second lateral extensions of the free layer structure respectively for longitudinally biasing the first and second lateral extensions of the free layer structure respectively.

18. (Original) A method as claimed in claim 17 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).

19. (Original) A method as claimed in claim 18 further comprising the steps of:

making a write head including the steps of:

forming ferromagnetic first and second pole piece layers that have a yoke portion between a pole tip portion and a back gap portion;

forming a nonmagnetic write gap layer between the pole tip portions of the first and second pole piece layers;

forming an insulation stack with at least one coil layer embedded therein between the yoke portions of the first and second pole piece layers; and

connecting the first and second pole piece layers at their back gap portions;

a making of the read head further including the steps of:

forming a ferromagnetic first shield layer; and

forming the sensor between the first shield layer and the first pole piece layer.

20. (Original) A method as claimed in claim 19 wherein the free layer structure is formed between pinned layer and the first pole piece layer.

21. (Original) A method as claimed in claim 20 wherein the pinned layer is formed between the free layer structure and the first pole piece layer.

Add new claims 22-35.

22. (New) A method of making a magnetic head assembly that has a head surface comprising:

forming a read head that has a current perpendicular to planes (CPP) sensor;

a making of the CPP sensor comprising the steps of:

forming a ferromagnetic pinned layer that has a magnetic moment;

forming an antiferromagnetic pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer;

forming a ferromagnetic free layer structure that has a magnetic moment; and

forming a nonmagnetic spacer layer between the free layer structure and the pinned layer;

forming each of the pinned layer and the spacer layer with first and second side surfaces which are perpendicular to the head surface;

forming first and second electrically nonconductive antiferromagnetic (AFM) layers with the first AFM layer interfacing the first side surfaces of the pinned and spacer layers and the second AFM layer interfacing the second side surfaces of the pinned and spacer layers so as to define a track width of the read head between said first and second side surfaces of the pinned and spacer layers;

forming the free layer structure with first and second lateral extensions which extend laterally away from first and second side extremities respectively of said track width; and

forming said first and second AFM layers exchange coupled to the first and second lateral extensions respectively commencing at said first and second side extremities of the track width respectively and extending laterally therefrom for longitudinally biasing the first and second lateral extensions respectively of the free layer structure and thence a central portion of the free layer structure within said track width.

23. (New) A method as claimed in claim 22 further comprising the steps of:

forming the free layer structure with first and second free layers;

forming the first free layer within said track width and with first and second side surfaces that are coextensive with the first and second side surfaces respectively of the spacer layer;

forming the first and second AFM layers also interfacing the first and second side surfaces respectively of the first free layer; and

forming the second free layer with said central portion and further with said first and second lateral extensions of the free layer structure.

24. (New) A method as claimed in claim 22 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).

25. (New) A method as claimed in claim 22 further comprising the steps of:

forming a write head comprising the steps of:

forming ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

forming a nonmagnetic write gap layer between the pole tip portions of the first and second pole piece layers;

forming an insulation stack with at least one coil layer embedded therein between the yoke portions of the first and second pole piece layers; and

connecting the first and second pole piece layers at their back gap portions;

a making of the read head further comprising the steps of:

forming a ferromagnetic first shield layer; and

forming the sensor between the first shield layer and the first pole piece layer.

26. (New) A method as claimed in claim 25 wherein the free layer structure is formed between pinned layer and the first pole piece layer.

27. (New) A method as claimed in claim 26 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).

28. (New) A method as claimed in claim 25 wherein the pinned layer is formed between the free layer structure and the first pole piece layer.

29. (New) A method as claimed in claim 28 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).

30. (New) A method of making a magnetic disk drive having at least one magnetic head assembly wherein the magnetic head assembly that has a head surface and that has a write head and a read head, comprising the steps of:

making the write head comprising the steps of:

forming ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

forming a nonmagnetic write gap layer between the pole tip portions of the first and second pole piece layers;

forming an insulation stack with at least one coil layer embedded therein between the yoke portions of the first and second pole piece layers; and

connecting the first and second pole piece layers at their back gap portions;

making the read head comprising the steps of:

forming a sensor with a central portion which defines a track width of the read head and first and second side portions on each side of the central portion; and

forming the sensor between a first shield layer and the first pole piece layer;

making the sensor comprising the steps of:

forming a ferromagnetic pinned layer that has a magnetic moment;

forming an antiferromagnetic pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer;

forming a ferromagnetic free layer structure that has a magnetic moment; and

forming a nonmagnetic spacer layer between the free layer structure and the pinned layer;

forming each of the pinned layer and the spacer layer with first and second side surfaces which are perpendicular to the ABS;

forming first and second electrically nonconductive antiferromagnetic (AFM) layers;

forming the first AFM layer interfacing the first side surfaces of the pinned and spacer layers and the second AFM layer interfacing the second side surfaces of the pinned and spacer layers so as to define a track width of the read head between said first and second side surfaces of the pinned and spacer layers;

forming the free layer structure with first and second lateral extensions which extend laterally away from first and second side extremities respectively of said track width; and

forming said first and second AFM layers exchange coupled to the first and second lateral extensions respectively commencing at said first and second side extremities of the track width respectively and extending laterally therefrom for longitudinally biasing the first and second lateral extensions respectively of the free layer structure and thence a central portion of the free layer structure within said track width;

forming a housing;

forming a magnetic medium in the housing;

forming a support mounted in the housing for supporting the magnetic head assembly with said head surface facing the magnetic medium so that the magnetic head assembly is in a transducing relationship with the magnetic medium;

forming means for moving the magnetic medium; and

connecting a processor to the magnetic head and to the means for moving for exchanging signals with the magnetic head and for controlling movement of the magnetic medium.

31. (New) A method as claimed in claim 30 further comprising the steps of:

forming the free layer structure with first and second free layers;

forming the first free layer within said track width and with first and second side surfaces that are coextensive with the first and second side surfaces respectively of the spacer layer;

forming the first and second AFM layers also interfacing the first and second side surfaces respectively of the first free layer; and

forming the second free layer with said central portion and further with said first and second lateral extensions of the free layer structure.

32. (New) A method as claimed in claim 30 wherein the free layer structure is formed between pinned layer and the first pole piece layer.

33. (New) A method as claimed in claim 32 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).

34. (New) A method as claimed in claim 30 wherein the pinned layer is formed between the free layer structure and the first pole piece layer.

35. (New) A method as claimed in claim 34 wherein each of the first and second AFM layers is formed of nickel oxide (NiO).